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Accident investigation on a large construction project: An ethnographic case study

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Abstract

Unsafe acts are believed to account for approximately 80 to 90 percent of accidents. This paper will investigate this issue through exploring the reasoning behind the unsafe acts that resulted in a minor accident on a large construction project (+\$1B) in the UK. The study described here, part of a wider PhD project, was undertaken using an ethnographic approach. Participant observation enabled the researcher to be involved in the whole accident investigation process including witness statement interviews, informal discussions, post-accident reports and meetings. The understandings displayed by those involved in the minor accident included a desire for a lack of blame, with the incident being described as 'an act of god'. The study reveals intentional unsafe acts that were due to time pressures, an acceptance of the unsafe act as a social norm and a lack of planning and training. Without any investigation, this accident could have been attributed purely to a cable guide, which could have been considered an unsafe condition. However, through thorough investigation there were also four unsafe acts related to the accident discovered: three of which were intentional. The construction industry needs to shift its safety management effort towards the understanding and elimination of unsafe acts despite them being more difficult to identify and prevent than unsafe conditions. Changing intentional unsafe behaviours is one of the next steps for improving health and safety of the industry, and the insights from this paper add to the knowledge of why these unsafe acts occur.

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1. Introduction

In 1959, Heinrich stated that accidents are caused by an unsafe condition and/or an unsafe act. Since then, safety management systems have concentrated on eliminating both these areas, though there has been more focus on unsafe conditions on site. This is because physical evidence can be gathered to account for the accident [1] and hence relatively little effort devoted to reducing or eliminating unsafe acts [2]. Donald and Young [3] suggest that little remains to improve on in terms of physical conditions, and considering that approximately 80-90% of accidents are caused by unsafe acts, further construction safety improvement is hardly expected to improve without more concentration on the reduction or elimination of unsafe acts. The construction industry needs to shift its safety management effort towards the elimination of unsafe acts [2] despite them being more difficult to identify and prevent than unsafe conditions [1]. The aim of this paper is to explore safety attitudes and behaviors relating to a minor accident on a large construction project.

2. Workers mental process and unsafe acts

Reason [4] defined two types of unsafe acts: errors and violations. Reason asserts that the term violation denotes an intentional act, and in most accident databases, violations are far more common than errors [5]. As unsafe acts are often intentional [6] understanding why these intentional unsafe acts occur is an important step towards elimination. Cognitive theory aims to explain human behavior by understanding thought processes. In this theory, the assumption is made that thoughts are the primary determinant of behavior. There have been a few notable research efforts on workers' mental processes towards safe behaviors. Eagly & Chaiken [7] suggested that attitudes towards safety influence intention, which in turn affects behaviors. While this model has been useful to explain workers' mental processes, it omitted the perception of accidental risks, which is an important aspect of safety behavior analysis [2]. Mearns, Flin, & Gordon [8] build on this model, by emphasizing risk perception in their more comprehensive model. A recent model by Shin et al. [2] added a feedback loop, which is 'key to understanding a workers' mental process to safe behavior'.

2.1. Risk perception

Risk perception is defined as a workers subjective judgment on a risk [9]. The relationship between risk perception, risk taking behavior and injury experience are complex [10]. In the construction industry, work undeniably requires a higher tolerance to risk and risk taking behavior than the average occupation [11] and this is partly why some people work in the industry, as they like to take risks [12]. In construction, time and money are two important driving forces. This can mean that for operatives paid on 'price' there is a benefit to finishing quickly, but that often leads to taking risks and cutting corners [13].

2.2. Attitude

According to Shin et al. [2] to eliminate worker's unsafe acts, their safety attitudes need to be closely examined. An attitude is 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor' [7]. Workers attitudes towards risk tend to be optimistic, though this can change if a worker experiences a traumatic accident [2]. Attitudes towards behaviors refers to the degree to which a person has favorably or unfavorably evaluated the behavior [14] and are closely related to a combination of expected benefits and cost [2]. According to Shin et al. [2] there are five factors influence attitude towards behavior: habit, attitudes towards target, reward or punishment, norms and/or approval of significant others and self-identified outcomes.

2.3. Behavioral intention

Behavioral Intention (BI) is the ‘subjective probability that he or she will engage in a certain behavior’ [15]. BI is how willing, or how motivated, a person is to try to perform the behavior and is the single most proximate predictor of behavior [16]. According to Ajzen & Fishbein [17] most human behaviors are predictable based on intention. Behavioral intention depends on attitude towards behavior, the subjective norm and perceived behavioral control.

3. Research approach

This study investigated a minor accident that occurred on a large civil engineering project (+\$1B) using ethnography. Ethnography is an established qualitative research methodology that is becoming more regularly applied in the construction industry [18]. Ethnography often uses participant observation as a main research tool. This is particularly suited to studying sensitive issues (such as safety in construction) since it does not intervene with the activities being investigated [19] and can provide rich descriptions about poorly understood areas [20]. The participant observer in this scenario was involved throughout the accident investigation process. This consisted of being present during the witness statement taking, informal conversations with those involved, accident scene investigation and post-accident meetings and reports. It is important to outline the setting to enhance the chances of replicability [21]. The social setting was a mixture of formal (eg. recording of witness statements) and informal (discussions with participants) and this is highlighted in the ethnographic passages.

To enhance reliability, it is important for the researcher to ‘take a look in the mirror’ and identify how he and the social arena could influence the data, (see Oswald et al. [22]) in what is widely acknowledged as the reflexive turn. While an overt PhD safety researcher, from previous immersion into the setting the researcher believed he was perceived as a trainee safety advisor with little power or threat to participants, partly due to youthful looks, small height and the fact the researcher was often with the site safety advisor. In ethnographic work, validity may be its major strength due to reasons such as the ethnographer's common practice of living among participants, the opportunities for continual data analysis and comparison to refine constructs and that it is conducted in a natural setting [21]. The findings in this paper such as a lack of planning or training contributing to the accident are not new in the field of construction safety, and previous studies have tried to determine the generalizability of such findings through quantitative methods with large sample sizes. The importance of this work does not lie with the generalizability, but with the deep insight and understanding an ethnographic study can bring.

This study is grounded in a rationalist ontology and interpretivist epistemology, where reason is the primary source of knowledge [23]. The explanations by workers for their behaviors are reasoned and linked back to cognitive theory literature where appropriate. The data was recorded, coded and analyzed using software program nVivo, with the key findings being discussed in this paper. For ethical reasons, pseudo names have been used in the following passages.

4. Ethnographic findings

In late June (2014) an incident that had been described as ‘minor’ occurred at 6:30pm, at around the time the dayshift workers were leaving and the nightshift workers arriving. The information that had been passed to the health and safety team was that the injured person had suffered a facial injury and because it was a head injury, he had been taken to hospital as a precaution. The following morning the safety advisor of the area went to investigate what had happened, and I was fortunate to be able to accompany him.

4.1. ‘Why don’t you ask the people that were actually involved?’

Our first point of call was in the area where the incident took place. Upon arrival on site, the two supervisors were asked if they knew anything about the incident and whether it had been recorded in the accident book. One of the supervisors stated that it wouldn’t have been recorded because it was locked in his cupboard (so no-one would have had access last night). The other supervisor then reacted in an aggressive and confrontational manner asking:

'why don't you ask the people that were actually involved'. The safety advisor was of the opinion that his demeanor was unnecessary. He felt he had just asked a simple question, and since the people involved were not yet on site, he thought he would make enquiries with the two supervisors. The construction industry has been known to being confrontational and this can not only be a problem for the industry but also research [24].

4.2. *The injured person's witness statement*

Soon after, the injured person (Bob) arrived on site, and the safety advisor progressed to take a witness statement. The incident had occurred during the extension of the cables of a construction hoist, so that the hoist would be able to travel higher up. During the process the hoist was moved upwards in short jolts or bursts of 300mm. These short increments were used so that there was less chance of the reinstalled cable getting snagged or damaged. In Bob's witness statement he said that *'this meant looking over the handrails and downwards to view the cables'*. He described the accident as:

'I was looking over the handrail with the hoist travelling upwards when a cable guide above me came into contact with my hard hat pushing my head down against the handrail. I let out a yell to Terry who was at the controls and the hoist carriage stopped immediately. I was (head) jammed between the handrail and cable guide and I couldn't move until the carriage was lowered. Once released Terry called Gary (foreman) to inform him of the incident, after which the man basket was sent up and I was brought down to into the medical room, where my injuries were cleaned and dressed (cut to right cheek) and then I was escorted to hospital. At the hospital I was examined and the dressings were changed. I was brought back to site around 21.00 where I picked up my vehicle and drove home.'

Bob also admitted that he hadn't attended the hoist training on extending the system but that he had been *'a steel erector for over 30 years'* and *'consider myself competent to carry out this nature of work'*. While experience and confidence can be positive, overconfidence can be dangerous. The overconfidence effect is a well-established bias [25] that could have occurred here and can lead to a 'won't happen to me' attitude [5]; an attitude which is present in the industry [26].

The hoist system was described by the subcontractor's hoist engineer as *'one of the most complex'* he had been involved with. This was primarily because the structure was not vertical but at a slight angle. Despite not being trained for hoist training on extending system, the injured person felt *'competent to carry out this nature of work'*. Lichtenstein et al., [26] found that people tend to overestimate the safety conditions around them and their ability to control or prevent accidents, and considering the hoist system was complex and the injured person was not trained, an overestimation could have occurred here.

4.3. *'It was an act of god, could have happened to anyone'*

At the end of the witness statement, he made it clear that he thought no blame should be proportioned to anyone and this *'was just an accident'*, *'it could have happened to anyone'* and it was *'an act of god'* and nothing could have prevented it. 'Acts of god' or accidents occurring beyond their control [27] have too often been used as a defense for negligence such as drinking and driving [28];[29]. Bob was quite an old and experienced worker. The advisor thought he was perhaps accepting the accident because he was used to the safety expectations being lower since he was an older worker (over 50 years old). He tried to make it clear that in the worst case scenario, he could have been decapitated, if they had decided to go in bigger jumps than 300mm. The general foreman, Gary, thought that Bob was *'sound and a good worker'*. One of the key factors contributing attributed to the accident was that Bob had not been trained to safely work on the hoist system. Following the statement, the advisor and I spoke with Gary, who had sent him to work. He confirmed that he had not been on the 5-day training that he should have been on. He had sent eight workers to the training, but six had since left, one was ill and another was unavailable as he was working elsewhere. As the trained workers had not been replaced, it suggests that the department had either suffered from a lack of planning, or perhaps a lack of resources. Horner and Duff [30] stated that productivity of even routine work can benefit from rigorous planning and Hare et al., [31] believe that there is no reason why health and safety performance should not also benefit from the same rigor. It was confirmed by both the hoist subcontractor engineer (Terry) and another worker who had just recently been on the hoist training, that he would have benefited from

being on the training course. Specifically because he would have been aware that he shouldn't have put any part of his body outside the hoist. Though perhaps this lack of training isn't surprising considering Sawacha et al. [32] found that ninety-two percent of operatives reported that they had been asked to operate machinery without adequate training. The risk assessment also had stated this, but Bob had not been briefed or signed on to this risk assessment.

4.4. Hoist engineer's witness statement

Soon after, Terry arrived on site. He was the Hoist engineer and witness of the accident. The safety advisor was of the opinion that his witness statement seemed *'very honest, but also very damming'*. There was a major concrete pour that was to occur on the nightshift and hence there was significant time pressure on the lengthening the cable system. The strength of the language in the daily logbook (for correspondence between day workers and nights) perhaps gave an indication to these pressures: *'... nite. Got all done. Hoist wasn't running till 11. Still need to get those slabs in. Catch you soon bro. Stay safe.'*

Terry was asked if there was any way he could have done a quick temporary job, and then come back at a more relaxed time and do a proper job. Terry hence tried to use all the slack in the cable system to make the cable reach the required height, but he found it to be one meter short and hence a 'proper job' was required. He admitted that he knew that Bob was not trained and that Gary also knew. Being untrained for the job, the workers involved knew they were committing an unsafe act, but this perhaps is not surprising considering most unsafe acts are intentional [6]. Gary said he was the *'best worker he had'*, and if it was OK if Bob came up with him. He stated that he had worked with Bob before on similar tasks, that he was an excellent worker and was much *'better than some of the other guys that had been trained'*; hence he was happy to work with him again. The fact that Bob had worked with the Hoist Engineer before represents that 'near misses' have previously occurred i.e. a worker doing a job he was not trained for. Since this unsafe act had happened multiple times, this suggests that this behavior was accepted by those in the environment and could have perhaps developed into a habit. In the theory of planned behavior [16], one of the key variables of behavioral intention is normative beliefs and subjective norms. This is an individual's perception of the social normative pressures and the perception about the specific behavior, and is influenced by significant others. Hence, the social acceptance by others in the environment could have had an influence on the recurring decision to commit this unsafe behavior. Terry admitted he was aware of his surroundings but was not keeping an eye on Bob. This lack of awareness could have been due to overconfidence and complacency since they had worked together before on similar jobs without an accident. Terry's witness statement:

'I always give the warning 'going up' prior to moving the carriage. We were both watching the cable to ensure it wasn't being damaged. We had travelled approximately 20m in total when Bob shouted 'stop'. This coincided with me hitting the 'stop' button and not purely because Bob shouted. The stop button is pressed as a matter of course every time we stop travelling. As I looked towards Bob I could see he was stuck between the handrail and cable guide by his head. I immediately pulled the stop button out and travelled down approx. 500mm to release Bob. I checked him out and other than a cut to his right cheek he seemed OK and he indicated he was OK. In fact he wanted to carry on with the task. I insisted he got medical attention. I then phoned Gary and shortly afterwards the man basket was sent up and Bob was taken down. I remained on the Hoist to make it safe. Bob was escorted down by the N/S banksman. I know Bob hadn't received the Hoist 5 day training course. I have worked with Bob on a number of occasions and feel he is a competent man.'

In a discussion which followed the witness statement taking, there was a delay in getting him down because the incident occurred between day and night shift, which meant a crane operator was not present. This could have been of greater concern if the injury was more severe and the injured person needed attention urgently. Though it was not pivotal in this incident it, a weakness in the safety management system was highlighted. Fortunately this weakness was not exploited on this occasion as Bob's injuries were not more severe (e.g. major loss of blood). Despite being injured Bob had a desire to carry on working, which demonstrates a dimension of the construction industries well-documented macho culture [33].

4.5. *'Butchered is perhaps a harsh word, that may make vegetarians amongst us uncomfortable'*

Following the gathering of evidence, a meeting was organized with the head of section, who was from mainland Europe. The head of section generated a report that pointed the blame towards the hoist engineer (Terry). He was of the opinion that *'as the trained and competent worker delivering a specialist operation he should have delivered it safely'*. He should have given some form of training to Bob. The safety advisor disagreed, suggesting that legally as the principal contractor they should be managing such situations properly, though he acknowledged Terry should not have accepted an untrained worker. This clash of opinion could have come from expected different working practices in different countries. In an informal discussion prior to the meeting, the foreman, Gary admitted he was prepared *'to take a bit of wrath'* or in other words, some form of disciplinary action, but as he sent him up with a trained and competent subcontractor (Terry), he wouldn't take all responsibility. He was keen *'to make a lessons learned and move on'*. Though there was disagreement on the accountability, they did all agree that the accident could have been worse. The advisor made the point that had the hoist gone up in bigger installments, the injured person could have had his head *'butchered off'*. Though the head of section made a light-hearted comment surrounding the word choice, he agreed it was a serious incident that could have been worse.

A few weeks after the incident, the subcontractor hoist engineer, Terry told the safety advisor that he had been asked to do it again - do a job with a worker that wasn't trained. The superior who asked him had not been involved in the previous accident, and explained they were under significant work pressures. Terry refused to go up with someone that wasn't trained despite this pressure. For Terry the accident had been quite upsetting; he had mentioned he felt *'bad'* for Bob, and that he *'should have seen it coming'*. Following traumatic events, people can perceive an increased level of risk [34], and considering Terry refused to commit a similar unsafe act when asked by a manager, this suggests that his risk perception levels had increased. Though previous accidents can change workers attitudes to being more pessimistic towards risk, this can gradually return to an optimistic state by forgetting the accident as time passes [2].

4.6. *Ethnographic findings in context*

The above ethnography of the investigation has allowed for interpretation of the reactions to the accident. The reasoning for the actions undertaken has been grounded within the relevant literature and summarized below.

Unsafe acts are often intentional [6] as workers decide to err from safe practices. In this scenario, the decision to use a worker who was untrained for the task represents an intentional unsafe act. This intentional act had been repeated several times previously, suggesting that it had become a social norm in the environment - an important factor in the behavioral intention [16]. Unsafe acts can also be unintentional, and Bob looking over the hoist was an example of this - as he had not been trained, he was not aware this was an error. These errors can be reduced through safety education, good supervision, system design etc [5]. This is perhaps why he saw the event as *'an act of god'* or beyond anyone's control. There could have also been an element of the overconfidence effect [25] and complacency, as people tend to overestimate the safety conditions around them and their ability to control or prevent accidents [26]. His desire to work on despite being injured perhaps suggests a dimension of the well-documented macho culture (e.g. [33]) in the industry. Risk perceptions can change, especially following a traumatic accident [34] and this was the case for Terry, who refused to commit the unsafe act again despite being asked by a manager above him in the hierarchal structure. Although aware of the incident, this superior was not involved and hence his risk perception was unlikely to change purely on awareness, due to the *'won't happen to me'* attitude [35]. The general foreman who sent Bob to work was *'prepared to take a bit of wrath'*, suggesting he was aware his act was unsafe. His decision to send an unskilled worker could have been influenced by the fact it had been done before (social norm), time pressures, lack of other trained operatives and that the unskilled worker was accompanied by a suitably trained employee from a specialist subcontractor. A competitive tendering process [36] creates pressure on time, which is an external environment factor that can influence behavior. In this case, there was a large concrete pour looming which added pressure.

5. Conclusions

Unsafe conditions have received more attention than unsafe acts because there is usually physical evidence that the accident can be attributed to. Without any investigation, this accident could have purely been attributed to the cable guide (unsafe condition) which caused the injured persons head to be jammed. However with further investigation multiple unsafe acts led to this accident. Unsafe acts included: the foreman sending a worker to do a task he wasn't trained for, the trained hoist engineer accepting this untrained worker, the untrained worker putting his head outside the hoist and even though it had no bearing on the accident, the work was carried out when no crane operator was present (to help with egress from the hoist should an incident occur). Three out of the four unsafe acts were intentional errors with the untrained workers act appearing to be an error. As the untrained worker seemed unaware of his unsafe act, he believed the accident was 'an act of god'. The foreman was aware of his wrong-doing and was prepared to take 'a bit of wrath'. The trained hoist engineer showed an increase in risk perception levels following the accident by refusing to commit the unsafe act again despite being asked by a manager. The unsafe act of sending and accepting untrained workers for a job had occurred before, suggesting that this was an accepted behavior within the social environment. The lack of planning and/or resources had created an environment where the behavior to train the individual became more undesirable due to the time pressures involved. Changing such intentional unsafe behaviors is one of the next steps for improving health and safety of the industry, and the insights from this paper add to the knowledge of why these unsafe acts occur.

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